

REMARKS

Rejections under 35 U.S.C. §103

Claims 1, 3-8 and 10-20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 08-174590 ("JP '590") in view of U.S. Patent No. 5,475,037 to Park et al. ("Park et al. '037"). This rejection is respectfully traversed.

JP '590 and Park et al. '037 – Discussion of Crystalline v. Amorphous Polyester

The Office Action continues to acknowledge that **Park et al. '037 pertains to an amorphous polyester**, however the Office Action ignores the fact that **JP '590 pertains to a crystalline polyester**, and that "crystalline" is antithetical to the term "amorphous."

The amorphous polyester of Park et al. '037 comprises isophthalic acid as a co-monomer in a concentration of 15 to 50%. See column 3, lines 15-16. This is because it is impossible to provide the amorphous polyester if the isophthalic acid concentration is lower than 15%.

In contrast, the polyester in JP '590 is crystalline. The claimed polyester is also crystalline, and comprises isophthalic acid as a co-monomer in a concentration of 0.5 to 10%, i.e., lower than 15%. Generally, a polyester comprising isophthalic acid as a co-monomer in a concentration of not lower than 15% is amorphous, and in no way crystalline.

The Office Action incorrectly states the following: "The examiner notes that the combined teachings of JP '590 and Park clearly point to a suitable co-monomer concentration in the range of less than 15 wt%, which encompasses the instantly claimed 0.5 to 10 wt%. As such, the examiner asserts that, in the absence of unexpected results, a suitable co-monomer concentration is either implicitly disclosed by JP '590 in view of Park...." See Office Action at page 4, third paragraph.

However, **JP '590** states nothing about the co-monomer concentration, but rather **teaches the range of crystallinity**. Park et al. '037 discloses the amorphous polyester comprising isophthalic acid as the co-monomer in a concentration of 15 to 50% (see column 3, lines 15-16), but does not disclose, teach or suggest a crystalline polyester comprising isophthalic acid as the co-monomer in a concentration lower than 15%.

The amorphous polyester of Park et al. '037 is not applicable to the present claimed crystalline polyester because the crystalline polyester is intrinsically different from the

amorphous polyester. Accordingly, the examiner's understanding of JP '590 and Park et al. '037 is incorrect, especially as stated at page 4, lines 6-11 and 15-18.

Still further, according to JP '590, "The crystallinity of the prepuffs is preferably not higher than 25%, more preferably not higher than 20%, further more preferably not higher than 15%." See column 3, lines 35-38. However, the crystallinities of the foamed sheets prepared according to Examples 1-3 in JP '590 are:

	Crystallinities	
	Surface portion of foamed sheet	Center portion of foamed sheet
Example 1	10%	10.5%
Example 2	8.6%	9.0%
Example 3	10.3%	10.5%

Mr. Hirai, who is the inventor of JP '590 and the present invention, makes the following statement in Declaration #2, submitted concurrently herewith: "When I made the invention of JP '590, it was impossible to prepare a prefoamed product having a surface crystallinity of lower than 8.6% and a center crystallinity of lower than 9.0%."

In practice, the prepuffs prepared according to JP '590 have a lower crystallinity limit of 8.6%, even though the specification of JP '590 states that the crystallinity of the prepuffs is preferably not higher than 25%.

In contrast, the present invention for the first time prepares prepuffs having a crystallinity of 1 to 8%. Therefore, the novel claim element is the crystallinity in the range of from 1% to 8%.

The meaning and effect of the crystallinity of the prepuffs in the range from 1% to 8% are described in detail in the Experiment report previously submitted, the translation of which is attached hereto.

As described in the Experiment Report, the prepuffs prepared in Experiment 1 have a crystallinity of 7.4%, and the prepuffs prepared in Experiment 2 have a crystallinity of 8.5%. The prepuffs prepared in Experiment 3 have a crystallinity of 1.4%, and the prepuffs prepared in Experiment 4 have a crystallinity of 0.5%.

The molded foam products produced from the prepuffs having a crystallinity within the range from 1% to 8% in Experiments 1 and 3 each have advantageous fusion ratio, flexural strength

and deflection. In contrast, the molded foam products produced from the prepuffs having a crystallinity outside the range from 1% to 8% in Experiments 2 and 4 each have an unacceptable fusion ratio, flexural strength and deflection.

In summary, this present invention makes it possible for the first time to prepare prepuffs having a crystallinity in the range from 1% to 8%, which is therefore novel and unobvious over the applied references.

Continued Discussion

Claim 1 recites pre-expanded foam particles formed from a moldable crystalline aromatic polyester resin, said particles having a bulk density in the range of from 0.01 to 1.0 g/cm³, crystallinity in the range of from 1 to 8% and a crystallization peak temperature in the range of from 130 to 180°C, wherein the resin contains at least one moiety of a moiety derived from isophthalic acid or a moiety derived from 1,4-cyclohexanedimethanol in a total amount ranging from 0.5 to 10% by weight of the crystalline aromatic polyester resin.

See, for example, the specification at page 6, last paragraph to page 7, line 4 and page 11, line 12 to page 12, line 7.

The crystallization peak temperature is the temperature at which a maximum crystallization speed is reached during a heating process. The crystallization peak temperature is a function of the materials used to form the pre-expanded foam particles. For example, the present specification (page 9, lines 20 to 24) teaches that PET has a crystallization peak temperature that does not reach 130 °C. As claim 1 recites, where the resin pre-expanded foam particle contains at least one moiety of a moiety derived from isophthalic acid or a moiety derived from 1,4-cyclohexanedimethanol in a total amount ranging from 0.5 to 10% by weight of the crystalline aromatic polyester resin, the crystallization peak temperature is within the range set forth in this claim, and the crystallinity is in the range of from 1 to 8% . See Tables 5 to 7 (pages 72 to 74), Comparative Example 4, and the supporting text.

The concentrations established in the claims go directly to the chemical structure of the claimed moldable crystalline aromatic polyester resin pre-expanded foam particle. This is in contrast to concentrations of elements in a mixture or solution. The claimed range of isophthalic acid or 1,4-cyclohexanedimethanol provides superior results compared to resins having such

monomer components outside of such a range.

Accordingly, when heating and fusing the pre-expanded particles to produce a molded foam article, the fusion between the pre-expanded particles is excellent, thereby making it possible to produce a cavity-molded foam article having excellent mechanical strength with the pre-expanded particles having crystallinity in the range of from 1 to 8%. This effectiveness is discussed variously in the specification, for example, page 26, line 23 to page 27, line 17 and at page 36, lines 20-25.

To demonstrate the criticality of the crystallinity range, an executed Declaration by the inventor was submitted concurrently with the Amendment filed January 21, 2004. The inventor declared that pre-expanded particles having a crystallinity in the range of 1 to 8% is critical. None of the cited references discloses or suggests pre-expanded particles having a crystallinity in the range of 1 to 8%, or the advantages resulted therefrom.

According to the Experiment Report (November 7, 2003) attached to the previous Declaration, a translation of which is attached to this Request, the fusion ratio of a molded foam article is 55% when using pre-expanded particles having a 7.4% crystallinity. In contrast, an excellent fusion ratio of a molded foam article is 91% when using pre-expanded particles having a 1.4% crystallinity. This is summarized in the table attached to the Experiment Report. However, the fusion ratio of a molded foam article is a low value of 38%, using pre-expanded foam particles having a crystallinity of 8.5%. Moreover, the fusion ratio of a molded foam article made with pre-expanded particles have a crystallinity of 0.5% is not measurable.

As acknowledged by the Examiner, JP '590 teaches an expanded material which has a bulk density of 0.02 to 0.7 g/cm³, but makes no mention of the bulk density of the pre-expanded particles which, prior to being expanded, form the expanded material. See Office Action (Paper No. 9) at paragraph 4, lines 4-11. There is no reason that a person of ordinary skill in the art would determine that a pre-expanded foam particles should have the presently claimed bulk density based on JP '590, when JP '590 explicitly teaches that the only material that has a bulk density which reads on that of the present claims is already in an expanded state.

Further, claim 1 teaches that the pre-expanded foam particles have "a crystallization peak temperature in the range of from 130 to 180°C." Even in the event that a person of skill in the art would happen to form a pre-expanded foam particles of the claimed bulk density discussed above from application of the teachings of JP '590, it would not naturally follow that the pre-expanded

foam particles obtained thereby would have the claimed crystallization peak temperature. Discussed above, the crystallization peak temperature is the temperature at which a maximum crystallization speed is reached during a heating process. The crystallization peak temperature is a function of the materials used to form the pre-expanded foam particles. For example, the present specification (page 9, lines 20 to 24) teaches that PET has a crystallization peak temperature that does not reach 130 °C. Compare this with JP '590, which teaches that PET is the most preferred resin used to form an expanded material (paragraph 0015). As claim 1 recites, where the resin pre-expanded foam particle contains at least one moiety of a moiety derived from isophthalic acid or a moiety derived from 1,4-cyclohexanedimethanol in a total amount ranging from 0.5 to 10% by weight of the crystalline aromatic polyester resin, the crystallization peak temperature is within the range set forth in this claim. Applicants note that JP '590 (paragraph 0015) teaches that compounds such as isophthalic acid and cyclohexane dimethanol can be included to obtain the resin that forms the expanded material. However, JP '590 fails to teach that these compounds merely form a minor part of the resin, but instead teaches that these compounds are used as monomer units that make up a totality of a polymer. A person of ordinary skill in the art would, at best, be motivated to form a resin having a much higher concentration than 0.5 to 10% of the isophthalic acid or 1,4-cyclohexanedimethanol from reviewing JP '590, and would therefore not reach the features of claim 1. More fundamentally, the person of ordinary skill in the art would not be motivated to form a resin material having the crystallization peak temperature in light of the deficient teachings of JP '590 in this respect.

The Office Action makes the sweeping assertion that "it is well known that the crystallinity of PET can be modified by copolymerizing terephthalic acid with cyclohexanedimethanol and/or isophthalic acid." See Paper No. 9 at paragraph 4, lines 13-15 and at Paper No. 0915 at paragraph 8, lines 21-23. However, both JP '590 and Park et al. '037 do not disclose, teach or suggest that pre-expanded particles have a crystallinity in the claimed range of 1 to 8%. The alleged knowledge of how to modify crystallinity does not disclose, teach or suggest the range of desired crystallinity of pre-expanded particles. Accordingly, this rejection does not rise to the level of prima facie obviousness. Withdrawal of this rejection is requested.

The Office Action further alleges that Park et al. '037 teaches a low density foam formed from an amorphous polyethylene terephthalate copolymer via molding of expanded foam particles,

and that the copolymer resin can be obtained by copolymerizing isophthalic acid and cyclohexanedimethanol, or mixtures thereof, in an amount of from about 15% to about 50% of the total copolymer formed thereby. Although these percentages (presumed to be measured by weight) are higher than the claimed concentrations in former claim 2, the Office Action asserts that *in the absence of unexpected results* obtained through the claimed concentrations, it would have been obvious to one skilled in the art to modify Park et al. '037 as combined with JP '590 to reach the presently claimed invention.

Still further, in paragraph 1 of the Advisory Action, the arguments presented in Applicant's previous response were entered, yet we not addressed in the Advisory Action, except to argue that Park allegedly "teaches that by incorporating greater than 15 wt% of the co-monomers, an amorphous polyester, rather than a crystalline polyester is obtained. As such, it is believed that a suitable small amount of the aforementioned co-monomers is either inherently disclosed by JP '590, or an obvious optimization to one skilled in the art" This is repeated in the Office Action at page 3, lines 17 to page 4, line 2.

Applicant respectfully traverses the rejection in light of the appropriate rule of law concerning optimization of ranges and differences in chemical structures, and the evidence presented in the present specification of the criticality of the claimed concentration (0.5 to 10%) of either 1,4-cyclohexanedimethanol or isophthalic acid and the superior results obtained from such a concentration and the claimed pre-expanded particles having a crystallinity of 1 to 8%. M.P.E.P. § 2144.05 instructs that an invention is not obvious over prior art that discloses differences in concentrations between chemicals in the prior art and in a claimed invention, where there is evidence on record establishing the criticality of the claimed concentration. The present specification clearly establishes evidence showing the criticality of having between 0.5 and 10% of either 1,4-cyclohexanedimethanol or isophthalic acid in the moldable crystalline aromatic polyester resin pre-expanded foam particles of the invention, as well as 1 to 8% crystallinity of the pre-expanded particles. The claimed concentration is not one selected merely to avoid the prior art *ex post*. Rather, the specification and claims as filed repeatedly suggest the criticality of the claimed parameters.

On page 12, lines 8 to 16, the specification teaches:

"When the total content of the IPA unit and/or CHDM unit is smaller than 0.5% by weight, the effect of inhibiting the crystallization is not exerted. On the other hand, when the content of the IPA unit and/or CHDM unit exceeds 10% by weight, the crystallization rate becomes too slow. In either case, a molded foam article or a laminated molded foam article, having a good appearance, strength, and heat-resistance can not be produced....

Clearly then, the present application teaches that the intended product produced by the present invention can not be produced when the ranges of the IPA (isophthalic acid) or the CHDM (1,4-cyclohexanedimethanol) are outside of the claimed range. This statement is, of course, evidence establishing criticality of the claimed range, and is sufficient to satisfy an obviousness rejection. Further, the statements are supported by experimental evidence provided in the present specification. See Tables 5 to 7 (pages 72 to 74), Comparative Example 4, and the supporting text for experimental evidence supporting these statements. See also inventor declaration, discussed above.

Also, it is respectfully pointed out that the concentrations established in the claims go directly to the chemical structure of the claimed moldable crystalline aromatic polyester resin pre-expanded foam particle. This is in contrast to concentrations of elements in a mixture or solution. M.P.E.P. §2144.09 instructs that an assertion of obviousness based on structural similarity is overcome by proof that the claimed compound provides unexpected results or possesses superior properties. The above discussion clearly explains how the claimed range of isophthalic acid or 1,4-cyclohexanedimethanol provides superior results compared to resins having such monomer components outside of such a range. For at least the above reasons, it is respectfully requested that the rejections of the claims be withdrawn.

Accordingly, even if a prima facie case of obviousness was established, as the Examiner has not contradicted the criticality of the claimed range or the superior properties, the obviousness is overcome, and the rejection should be withdrawn.

Still further, "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability

of the modification.” *In re Fritch*, 972 F.2d 1260, 23 USPQ 2d 1780 (Fed. Cir. 1992).

Accordingly, a prima facie case of obviousness has not been established, and the rejection should be withdrawn.

For all of the reasons discussed above, a prima facie case of obviousness has not been presented by the examiner, and the rejection should be withdrawn.


Additionally, dependent claims 3-8 and 10-20, being dependent upon allowable claim 1, are also allowable for the reasons above. Moreover, these claims are further distinguished by the additional features recited therein, particularly within the claim combination.

Conclusion

For the foregoing reasons, claims 1, 3-8 and 10-20 are in condition for allowance. Accordingly, favorable reexamination and reconsideration of the application in light of these amendments and remarks is courteously solicited. If the examiner has any comments or suggestions that would place this application in even better form, the Examiner is requested to telephone the undersigned attorney at the number below.

Respectfully submitted,

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Should additional fees be necessary in connection with the filing of this paper, or if a petition for extension of time is required for timely acceptance of same, the Commissioner is hereby authorized to charge Deposit Account No. 180013 for any such fees; and applicant(s) hereby petition for any needed extension of time.

PRE-EXPANDED PARTICLES OF CRYSTALLINE AROMATIC
POLYESTER-BASED RESIN, AND IN MOLD EXPANDED PRODUCT AND
EXPANDED LAMINATE USING THE SAME

English translation of the Experiment Report dated
November 7, 2003, experimented by Mr. Takaaki HIRAI

EXPERIMENT 1

First, 100 parts by weight of a thermoplastic polyester resin (isophthalic acid content: 1.7 wt%, 1,4-cyclohexanedimethanol content: 0 wt%, crystallization peak temperature: 135.0°C, IV value: 0.80) synthesized by polycondensation of ethylene glycol, isophthalic acid and terephthalic acid, 0.30 parts by weight of pyromellitic dianhydride as a modifier, and 0.03 parts by weight of sodium carbonate as an auxiliary modifier were charged in an extruder (diameter: 65mm, L/D ratio: 35), and melted and mixed at a barrel temperature of 270 to 290°C with a screw of the extruder rotated at a rotation speed of 50 rpm. At the same time, butane (n-butane/isobutane=7/3) as a foaming agent was added to the resulting mixture in a proportion of 1.3 wt% based on the weight of the mixture by injection thereof from an injection pipe connected to a middle portion of a barrel of the extruder.

In turn, the molten mixture was extruded from

nozzles of a multi-nozzle die (15 nozzles linearly arranged and each having a diameter of 0.8mm) connected to a distal end of the barrel, and prefoamed. Then, the resulting prefoamed strands were cooled in a cooling water bath.

The prefoamed strands thus cooled were sufficiently dewatered, and then cut into prepuffs by means of a pelletizer.

The resulting prepuffs had a bulk density of 0.12g/cm^3 , and each had a particle diameter of 1.5 to 2.4mm and a crystallinity of 7.4%. Then, the prepuffs were put in an airtight container into which carbon dioxide gas was supplied at a pressure of 0.49MPa, and maintained in this state for 4 hours. The prepuffs were filled in a mold having interior dimensions of 300mm×400mm×20mm immediately after being taken out of the airtight container, and the mold was clamped. Subsequently, steam was supplied into the mold at a gage pressure of 0.02MPa for 10 seconds, and then at a gage pressure of 0.06MPa for 20 seconds. Thus, the prepuffs were thermally expanded and fuse-bonded to one another.

In this state, the mold was allowed to stand for 120 seconds, and then cooled with water. Thus, a molded foam article was produced. The molded foam article had a density of 0.12g/cm^3 , a fusion ratio of 55%, a flexural strength of 1.02MPa, and a deflection of 6.23mm.

EXPERIMENT 2

First, 100 parts by weight of a thermoplastic polyester resin (isophthalic acid content: 1.7 wt%, 1,4-cyclohexanedimethanol content: 0 wt%, crystallization peak temperature: 135.0°C, IV value: 0.80) synthesized by polycondensation of ethylene glycol, isophthalic acid and terephthalic acid, 0.31 parts by weight of pyromellitic dianhydride as a modifier, and 0.03 parts by weight of sodium carbonate as an auxiliary modifier were charged in an extruder (diameter: 65mm, L/D ratio: 35), and melted and mixed at a barrel temperature of 270 to 290°C with a screw of the extruder rotated at a rotation speed of 50 rpm. At the same time, butane (n-butane/isobutane=7/3) as a foaming agent was added to the resulting mixture in a proportion of 1.4 wt% based on the weight of the mixture by injection thereof from an injection pipe connected to a middle portion of a barrel of the extruder.

In turn, the molten mixture was extruded from nozzles of a multi-nozzle die (15 nozzles linearly arranged and each having a diameter of 0.8mm) connected to a distal end of the barrel, and prefoamed. Then, the resulting prefoamed strands were cooled in a cooling water bath.

The prefoamed strands thus cooled were sufficiently dewatered, and then cut into prepuffs by means of a

pelletizer.

The resulting prepuffs had a bulk density of 0.11g/cm^3 , and each had a particle diameter of 1.5 to 2.4mm and a crystallinity of 8.5%. Then, the prepuffs were put in an airtight container into which carbon dioxide gas was injected at a pressure of 0.49MPa, and maintained in this state for 4 hours. The prepuffs were filled in a mold having interior dimensions of 300mm×400mm×20mm immediately after being taken out of the airtight container, and the mold was clamped. Subsequently, steam was supplied into the mold at a gage pressure of 0.02MPa for 10 seconds, and then at a gage pressure of 0.06MPa for 20 seconds. Thus, the prepuffs were thermally expanded and fuse-bonded to one another.

In this state, the mold was allowed to stand for 120 seconds, and then cooled with water. Thus, a molded foam article was produced. The molded foam article had a density of 0.11g/cm^3 , a fusion ratio of 38%, a flexural strength of 0.76MPa, and a deflection of 1.63mm. The molded foam article was poor in appearance.

EXPERIMENT 3

First, 100 parts by weight of a thermoplastic polyester resin (isophthalic acid content: 7.3 wt%, 1,4-cyclohexanedimethanol content: 0 wt%, crystallization peak temperature: 153.9°C , IV value: 0.72)

synthesized by polycondensation of ethylene glycol, isophthalic acid and terephthalic acid, 0.32 parts by weight of pyromellitic dianhydride as a modifier, and 0.03 parts by weight of sodium carbonate as an auxiliary modifier were charged in an extruder (diameter: 65mm, L/D ratio: 35), and melted and mixed at a barrel temperature of 270 to 290°C with a screw of the extruder rotated at a rotation speed of 50 rpm. At the same time, butane (n-butane/isobutane=7/3) as a foaming agent was added to the resulting mixture in a proportion of 0.7 wt% based on the weight of the mixture by injection thereof from an injection pipe connected to a middle portion of a barrel of the extruder.

In turn, the molten mixture was extruded from nozzles of a multi-nozzle die (15 nozzles linearly arranged and each having a diameter of 0.8mm) connected to a distal end of the barrel, and prefoamed. Then, the resulting prefoamed strands were cooled in a cooling water bath.

The prefoamed strands thus cooled were sufficiently dewatered, and then cut into prepuffs by means of a pelletizer.

The resulting prepuffs had a bulk density of 0.22g/cm³, and each had a particle diameter of 1.4 to 2.0mm and a crystallinity of 1.4%. Then, the prepuffs were put in an airtight container into which carbon dioxide gas

was injected at a pressure of 0.49MPa, and maintained in this state for 4 hours. The prepuffs were filled in a mold having interior dimensions of 300mm×400mm×20mm immediately after being taken out of the airtight container, and the mold was clamped. Subsequently, steam was supplied into the mold at a gage pressure of 0.02MPa for 10 seconds, and then at a gage pressure of 0.06MPa for 20 seconds. Thus, the prepuffs were thermally expanded and fuse-bonded to one another.

In this state, the mold was allowed to stand for 120 seconds, and then cooled with water. Thus, a molded foam article was produced. The molded foam article had a density of 0.22g/cm³, a fusion ratio of 91%, a flexural strength of 1.36MPa, and a deflection of 11.0mm.

EXPERIMENT 4

First, 100 parts by weight of a thermoplastic polyester resin (isophthalic acid content: 7.3 wt%, 1,4-cyclohexanedimethanol content: 0 wt%, crystallization peak temperature: 153.9°C, IV value: 0.72) synthesized by polycondensation of ethylene glycol, isophthalic acid and terephthalic acid, 0.32 parts by weight of pyromellitic dianhydride as a modifier, and 0.03 parts by weight of sodium carbonate as an auxiliary modifier were charged in an extruder (diameter: 65mm, L/D ratio: 35), and melted and mixed at a barrel temperature of 270

to 290°C with a screw of the extruder rotated at a rotation speed of 50 rpm. At the same time, butane (n-butane/isobutane=7/3) as a foaming agent was added to the resulting mixture in a proportion of 0.6 wt% based on the weight of the mixture by injection thereof from an injection pipe connected to a middle portion of a barrel of the extruder.

In turn, the molten mixture was extruded from nozzles of a multi-nozzle die (15 nozzles linearly arranged and each having a diameter of 0.8mm) connected to a distal end of the barrel, and prefoamed. Then, the resulting prefoamed strands were cooled in a cooling water bath.

The prefoamed strands thus cooled were sufficiently dewatered, and then cut into prepuffs by means of a pelletizer. However, it was impossible to mold the resulting prepuffs to produce a molded foam article, because the prepuffs were aggregated. The prepuffs had a bulk density of 0.24g/cm³, and each had a particle diameter of 1.4 to 2.0mm and a crystallinity of 0.5%.

	Experiment			
	1	2	3	4
Material				
IPA content (wt%)	1.7	1.7	7.3	7.3
CHDM content (wt%)	0	0	0	0
Prepuffs				
Density (g/cm ³)	0.12	0.11	0.22	0.24
Crystallinity (%)	7.4	8.5	1.4	0.5
Molded foam article				
Fusion ratio (%)	55	38	91	-
Flexural strength (MPa)	1.02	0.76	1.36	-
Deflection (mm)	6.23	1.63	11.0	-